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# COMMENTARY: Neurotoxicology-Meet the Real World

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16. ABSTRACT

In 1962, world attention became focused on the environmental issues surrounding pesticide usage when Rachel Carson published her third book, "Silent Spring". Citing one case report after another, she documented how the indiscriminate use of pesticides was profoundly affecting the balance of nature and pleaded for a more prudent national policy governing such use. "I contend furthermore, " she said, "that we have allowed these chemicals to be used with little or no advanced investigation of their effect on soil, water, wildlife and man himself."

To some extent, "Silent Spring" ushered in the period of environmental concern which culminated in the early 1970's. The nationwide turn-out for the first "Earth Day" in April of 1970 showed unmistakably the nations's new environmental awareness. Since that time, we have witnessed the passage of major legislation designed to preserve or enhance environmental quality. The National Environmental Policy Act of 1970 led to the formation of the Environmental Protection Agency which now manages the Clean Air Act, 1970; the Federal Water Pollution Control Act, 1972; the Marine Protection Research and Sanctuaries Act, 1972; the Federal Insecticide, Fungicide and Rodenticide Act of 1948, amended in 1972; the Resources Conservation and Recovery Act, 1976; and the Toxic Substances Control Act, 1976.

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# COMMENTARY
# Neurotoxicology—Meet the Real World

LAWRENCE W. REITER

*Neurotoxicology Division, Health Effects Research Laboratory*
*US Environmental Protection Agency, Research Triangle Park, NC 27711*

"Future generations are unlikely to condone our lack of prudent concern for the integrity of the natural world that supports all life." Rachel Carson, 1962

IN 1962, world attention became focused on the environmental issues surrounding pesticide usage when Rachel Carson published her third book, "Silent Spring". Citing one case report after another, she documented how the indiscriminate use of pesticides was profoundly affecting the balance of nature and pleaded for a more prudent national policy governing such use. "I contend furthermore," she said, "that we have allowed these chemicals to be used with little or no advanced investigation of their effect on soil, water, wildlife and man himself."

To some extent, "Silent Spring" ushered in the period of environmental concern which culminated in the early 1970's. The nationwide turn-out for the first "Earth Day" in April of 1970 showed unmistakably the nation's new environmental awareness. Since that time, we have witnessed the passage of major legislation designed to preserve or enhance environmental quality. The National Environmental Policy Act of 1970 led to the formation of the Environmental Protection Agency which now manages the Clean Air Act, 1970; the Federal Water Pollution Control Act, 1972; the Marine Protection Research and Sanctuaries Act, 1972; the Federal Insecticide, Fungicide and Rodenticide Act of 1948, amended in 1972; the Resources Conservation and Recovery Act, 1976; and the Toxic Substances Control Act, 1976.

Whereas Rachel Carson focused on the environmental impact of pesticide use, the problem is larger and more fundamental. The myriad chemical substances resulting from industrialized technology are potentially as hazardous as pesticides. The magnitude of the problem associated with their production and disposal in the United States becomes immediately clear when available data are considered.

Recent figures provided by EPA's Office of Toxic Substances estimate that 60,000 chemicals are currently in use in the United States, with approximately 1,000 new chemicals being introduced into commerce each year. For many of these substances, inadequate toxicological data exists for evaluating safety. EPA also estimates that in the US alone, 4 billion metric tons of chemical waste are produced annually, of which 30–40 million metric tons are thought to be hazardous i.e., to pose an imminent danger to human health or the environment. Although this quantity of hazardous waste represents only 1% of the total, it corresponds to 300–400 pounds per man, woman, and child in the United States. I suspect that public concern for this problem would be markedly elevated if, on the first day of each year, individuals were provided with their annual allotment of this hazardous soup and made responsible for its safe disposition. In some respects, Love Canal is an example of what happens when we are asked to live in the midst of our chemical waste.

Clearly the potential hazard associated with the use and disposal of chemical substances should be of primary concern: as an environmental consumer it frightens me, as an environmental toxicologist it overwhelms me. In the 4 years since the passage of TSCA and RCRA, EPA has spent considerable time and money implementing these acts. Whereas simply defining the problems has been a monumental task, solving these problems is one of man's greatest challenges—for at stake is our very existence. It is unlikely that a single well placed stone will topple this goliath which threatens our environment. The battle must be fought on many fronts. Environmental monitoring and engineering, ecological and health effects each constitute major research areas. When these areas are further subdivided, the resulting labyrinth taxes the capacity of the most seasoned veteran.

Fortunately, our task as neurotoxicologists seems well defined: we must evaluate the effects of environmental chemicals on the functional integrity of the nervous system. It is interesting to note that in the same year Rachel Carson published "Silent Spring", an Oklahoma physician, Dr. Joseph Ruffin, wrote in the Journal of Occupational Medicine. (5: 117–121, 1962):

"The completion of toxicological investigation demands at least a balanced consideration for the potential of the chemical to cause central nervous system effects which may only be manifested by impairment of functions of the nervous system. The study of CNS functions or better still, *behavior*, in the broadest sense is the proper object for the attention of the experimental industrial toxicologist. If one accepts the advantages of the functions of the central nervous system as integral indicators of toxicity, the study of these functions becomes a truly indispensible part of the toxicological investigation."

There is little doubt that neurotoxicology has established itself as an essential component of toxicology. The fact that we now have two neurotoxicology journals (*Neurobehavioral Toxicology* and *Neurotoxicology*) exemplifies this importance. However, much of our effort has been spent on demonstrating the utility of our approach, establishing our

credibility. Chemicals of known neurotoxic potential have been investigated in order to demonstrate this utility. The time is now at hand to forcefully move into the mainstream of environmental toxicology and meet the challenge of the real world. To achieve this goal we must develop a research strategy which provides for the neurotoxicological evaluation of the multitude of chemicals which are present in our environment. This strategy must include the evaluation of chemical mixtures which are being encountered in ever increasing amounts.

As an environmental science, neurotoxicology must not only develop valid methods but also produce useful results. In 1921, Otto Loewi provided the first real proof of the chemical mediatior of nerve impulses. Using two frog hearts and a stimulator, he was able to demonstrate that vagusstoff (acetylcholine) was released by vagal stimulation. Where would we be today if he had waited for the development of the GC-mass spectrometer? Obviously, we must continue to improve upon our methodology, new methods must continually be developed and old methods must continually be refined, but this should not divert attention from our current research needs.

Environmental legislation should not lure us into a false sense of security; it represents only the beginning, the first step which puts into place the appropriate foundation on which to build a better environment. Responsible decisions concerning the protection of human health and the environment must be made on the basis of sound scientific data. The environmental scientist must assume responsibility for his data. If these data are born from good experimental design, they will likely contribute in some way to the environmental decision making processes. Regardless of the decision it supports, the science must be impeccable.